Melbourne's plant life – past and present

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Abstract
The native vegetation of the Melbourne region was heavily diminished in extent and composition by the turn of the 20th century. An account is given of the trends that have occurred, particularly over the past century. Clearing for agriculture began as a major cause of loss of native vegetation, ultimately overtaken by urban development. Remnants have been changed progressively by tree removal, naturalisation of non-indigenous species, grazing by stock, drainage works, altered fire regimes and ancillary effects. Substantial declines of some indigenous plant species during the record drought of 1997–2010 indicate what may be in store with future climate change. Red List assessments of the risk of local extinction of plant species are summarised for three Melbourne municipalities. Concerted intervention will probably be needed to avoid many local extinctions over the next decade or so. The assessments also reveal the nature of the threats faced and hence guide determination of measures that may avert them. (*The Victorian Naturalist* **128** (5) 2011, 175–181)

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Historical Records

This paper provides a botanical perspective on the theme, *Melbourne's Biodiversity – Past and Present*, adopted for the Field Naturalists Club of Victoria's 2010 Biodiversity Symposium. The region is taken to extend roughly 40 km from central Melbourne.

As a reference point the symposium adopted the Australasian Association for the Advancement of Science's *Handbook of Melbourne*, in which Topp (1900) provided a botanical chapter. Some of his descriptions reveal that by that time, large changes had occurred in the Melbourne region's vegetation during the 60 or so years since first settlement. He stated that 'there are still remains of the native vegetation' on the shores and hinterland of the eastern side of Port Phillip Bay from Brighton to Point Nepean. Sheoaks (*Allocasuarina*), he said, 'are now much less numerous, large numbers having been felled for many years past for firewood' (Topp 1900: 171).

Most of Topp's sketchy descriptions of the Melbourne region's native vegetation in 1900 still apply today. The exceptions are the heathlands of Cheltenham and Brighton that Topp (1900: 171) described as 'the chief collecting grounds of Melbourne botanists' and that have been destroyed long since. The following plant species were listed as abundant in those heathlands in 1900 and have since become rare in the whole Melbourne area:

- the sun-orchids *Thelymitra aristata, T. antennifera* and *T. flexuosa*
- Red-beaks *Pyrorchis nigricans*
- Tall Leek-orchid *Prasophyllum elatum*
- Blue Fairies *Cyanicula deformis*
- Spider-orchids of the *Caladenia patersonii* group
- Bearded Greenhoods of the *Pterostylis barbata* group
- Pink Swamp-heath *Sprengelia incarnata*
- the bladderworts *Utricularia dichotoma, U. lateriflora* and *U. tenella* and
- Pouched Coral-fern, *Gleichenia dicarpa.*

Overall, Topp's description of lowland parts of the eastern half of the Melbourne area creates an impression that it had already lost most of its indigenous cover but retained small pockets of bushland containing many more indigenous species than can be found there today. Topp's account does not provide much other information that helps to infer how the Melbourne region's flora has changed since 1900.

Reports of excursions in *The Victorian Naturalist* provide a valuable source of information about vegetation changes through the Field Naturalists Club of Victoria's long history. A good example is provided by a series of reports of day trips to Bayswater, in which Club members walked north from Bayswater train station, across Dandenong Creek toward Heathmont station. Those reports from 1906, 1907 and 1909 describe a very rich flora in a quite natural landscape, including the following spe-

cies that have since become very rare or extinct in the whole region: *Caladenia cardiochila, C. oenochila, Thelymitra flexuosa, Prasophyllum frenchii/pyriforme, Epacris gunnii, Comesperma ericinum* and *Phylloglossum drummondii*. A 1918 day trip added *Euphrasia collina* and *Hakea decurrens* to the list of species that have since vanished from the Bayswater–Heathmont district, followed by *Thelymitra antennifera* and *Pultenaea pedunculata* in 1929. A 1931 excursion reported that blackberries had smothered many of the understorey shrubs. There was a conspicuous decline in the number of reported species of particular note from 1929 to 1936, when it was reported that, 'Reaching the Dandenong Creek we were disappointed to find that many of the Silver Wattles, which formerly lined its banks, had been destroyed' (Audas 1936: 112).

This 1936 trip marked the end of the Club's excursions to Bayswater, in favour of locations further along the railway line. Specimens at the National Herbarium of Victoria show that uncommon orchid species were regularly collected along the railway line from Bayswater to Heathmont until the 1960s. In more recent decades, regular herbicide spraying along the railway line has contracted the habitat for orchids to small pockets above cuttings (Lorimer *et al.* 1997).

The types of vegetation change that occurred between Bayswater and Heathmont in the 20th century are typical of what occurred more generally in the Melbourne region since 1900. The most consistent features appear to be clearing, proliferation of non-indigenous plants and progressive loss of the more sensitive indigenous species, particularly orchids.

Major Causes of Change

Vegetation Loss

At all stages since first settlement, the greatest change in the region's native vegetation has been its steady loss. Agriculture was initially a major cause of loss, but urban development eventually engulfed most agricultural land and residual native vegetation. This process continues today, particularly in association with construction of new suburbs on native grasslands in the west and widespread major road projects (e.g. Section 6.1.5 of DSE (2009)). The commitment by the Victorian Government (NRE 1997) to reverse the decline in the extent and 'quality' of native vegetation by 2001 was far from achieved either statewide or in the Melbourne region (DSE 2008).

Tree Loss

Areas of forest and woodland in the Melbourne region have had their tree canopy mostly removed at one or more stages since settlement, particularly for low-grade timber and to feed the wood fires and boilers of the growing metropolis. For example, most of the Dandenong Ranges' forests had been cleared by the 1930s, leading Sir Arthur Streeton (a resident of Olinda) to paint *Last of the Messmates* in 1928 and *Our Vanishing Forests* in 1934 to draw attention to the destruction that had occurred. The forests that attract so many people to the Dandenong Ranges today are largely regrowth from that period, vindicating the efforts of conservationists like Sir Arthur to ease the exploitation of native vegetation.

The result of Melbourne's history of tree removal is that the remnants of forests and woodlands today are overwhelmingly regrowth, dominated by trees that are far younger and considerably denser than was normal prior to settlement. Many eucalypts within these remnants must die before reaching full size because their densities are higher than can be tolerated by fully grown eucalypts. In areas with high densities of young trees (as in areas burned on Black Saturday), an argument could be put that habitat values could be increased by thinning of trees to allow faster, healthier growth of the retained trees. Vesk (2008) discusses this issue in the context of revegetation.

Introduced Flora

Clearing natural vegetation can allow the naturalisation of non-indigenous flora and fauna that would otherwise not occur in old growth vegetation. Because the Melbourne region's native vegetation is overwhelmingly regrowth surrounded by abundant sources of non-indigenous flora and fauna, introduced species have become substantial components of the region's remnant vegetation. The smothering of indigenous shrubs by blackberries observed at Bayswater in 1931 is a good example of how

introduced organisms can displace indigenous species, change vegetation structure and composition, and significantly alter ecological processes (Audas 1932). The impact of introduced flora on native vegetation and ecological processes is discussed at length in *The Victorian Naturalist* **127**(4) 2010.

The encroachment of non-indigenous plant species into native vegetation is favoured by mesic conditions such as occur on floodplains. Consequently, dry ridges and hilltops feature strongly among the Melbourne region's most important sanctuaries for indigenous flora. Elevated parts of Studley Park in Kew and Pound Bend in Warrandyte are examples, with high botanical diversity and many rare and sensitive indigenous plant species.

Fragmentation of Habitat

The pattern of development of the Melbourne region has progressively fragmented the native vegetation into small patches and narrow corridors. As the habitat for a plant species becomes more fragmented, the fragments eventually become so far apart that pollen, seeds and spores are no longer able to be dispersed between them. Breeding, regeneration and re-colonisation can then fail. The problem is compounded because fragmentation causes not only physical separation of plant populations but also a decline in fauna (particularly birds and insects) that pollinate flowers and disperse seeds.

It is now normal to find a small but significant proportion of the indigenous plant species in an urban bushland remnant reduced to no more than a handful of individuals, showing little if any sign of successful reproduction.

The naturalness of habitat in small or narrow fragments is also compromised by 'edge effects' such as penetration of introduced plant species from surrounding land, due to the short distance between edge and centre.

Fragmentation of habitat is recognised globally as one of the main causes of loss of biodiversity. There are many revegetation projects in the Melbourne area designed to improve linkages between remnants of native vegetation, but many remnants will remain isolated indefinitely.

Loss of Riparian and Floodplain Habitat

Stream corridors, floodplains and wetlands are critical for wildlife habitat (Lorimer *et al.* 2010) and important for the continued existence of many plant species and vegetation types in the Melbourne region. Their fertile soils and high availability of soil moisture have caused them to be favoured for agriculture, as well as making them more susceptible to naturalisation of non-indigenous flora. However, some indigenous plant species are so well adapted to re-establishing following flood damage that they have proved rather resistant to displacement by non-indigenous species. Examples include River Red Gum *Eucalyptus camaldulensis*, Silver Wattle *Acacia dealbata*, Tree Violet *Melicytus dentatus* and knotweeds *Persicaria* spp. Riparian vegetation is characterised by the indigenous ground flora being disproportionately displaced by introduced species, compared with the indigenous shrubs and trees.

Riparian and floodplain vegetation has often escaped urban development because of the incidence of flooding. Consequently, a substantial proportion of the Melbourne region's remnant vegetation is along streams (albeit in a rather unnatural state, as a rule). However, golf courses, sporting fields and major road projects have increasingly displaced riparian vegetation over the past 50 years.

Another major cause of destruction and disruption of natural habitat along Melbourne's streams has been engineering works, particularly during the 1970s and 1980s, to replace streams with low-flow pipes beneath straight-segmented floodways. Not only have these works cleared a substantial proportion of riparian vegetation but the resultant changed hydrology has rendered the environment less fit for the types of vegetation that previously grew there.

Grazing of grassland

The Melbourne region stands out as a key area for the conservation of two vegetation types: native grasslands on the volcanic plain in the west and Valley Heathy Forest in the east. The region's native grasslands are important both for their representation of a highly threatened community and because of the presence of numerous rare species of flora and fauna.

These grasslands have been so heavily used as pasture, and for so long, that their pre-settlement composition has become difficult to determine. Sutton (1916: 112) described western Melbourne's grasslands thus: 'The area is not favoured for residential purposes, and has not much been built over; but it has been put so thoroughly to pastoral and agricultural uses that hardly any part remains in the virgin state'. The indigenous grassland flora took a further dive between the World War II and the 1960s due to accelerating application of superphosphate (Waring and Morris 1974), ploughing, and sowing with clover and ryegrass. Other causes of the decline of native grasslands, such as urban development and fragmentation, are described by Williams *et al.* (2005).

Fire

Many of the native vegetation communities in the Melbourne region cannot persist in a natural state without regeneration by fire. As examples of the more common communities in the region, Cheal (2010: p. 25) indicates 'maximum tolerable fire intervals' of 7 years for basalt grasslands, 45 years for heathlands and dry forests and up to 150 years for woodlands.

In Melbourne's bushland remnants, intervals between fires have often been much greater than optimal and sometimes greater than the maximum tolerable. Consequently, some fire-dependent species that were once very common have become rare in metropolitan Melbourne. Running Postman *Kennedia prostrata* is an example, but fire can stimulate germination of its seeds many decades after the parental generation dies out, as happened in abandoned orchards and pasture at several sites in Wantirna South and Wheelers Hill (Lorimer 2001).

Conversely, there is evidence that some indigenous plant species such as the Clover Glycine *Glycine latrobeana* have been severely depleted by burning at unnaturally high frequencies on grasslands, particularly those in railway reserves (Scarlett and Parsons 1993).

Drought and Climate Change

The Melbourne region endured a drought from 1997 to 2010 that broke numerous records for duration and intensity. The effects included decline in tree health and decimation of the populations of some previously abundant indigenous flora species such as Blackwood *Acacia melanoxylon*, Drooping Mistletoe *Amyema pendula* and Ivy-leaf Violet *Viola hederacea*. Lorimer (2007, 2010a, 2010b) provides evidence in the outer eastern suburbs. Plants of swampy ground were worst affected by the drought and have shown poor recovery so far.

Drought is part of Melbourne's natural environment, but apparently not to the extent experienced in 1997–2010 because there is now convincing evidence that human-induced climate change has played a major role in the dryness (e.g. Timbal 2009). Joint research by the Bureau of Meteorology and the CSIRO predicts that rainfall in Victoria will continue to trend lower (despite some wet spells), particularly in spring and (to a lesser degree) winter[1].

The Future

The most severe ongoing threats to Melbourne's indigenous plant species and communities include:

- predicted increased incidence and severity of drought
- clearing for residential development and major road projects
- weeds, and
- reproductive failure of plant species whose populations are fragmented into critically small, isolated subpopulations.

A guide to the magnitude of these threats is provided by studies of species' risks of local extinction in each of three municipalities: inner suburban Boroondara (Lorimer 2006) and the eastern fringe municipalities of Manningham (Lorimer 2010a) and Knox (Lorimer 2010c) (Fig. 1). The sizes of the municipalities are 60, 114 and 114 km^2, respectively. Each study applied the international standard 'Red List' criteria (IUCN 2001, 2003, 2008) to categorise the local extinction risk of almost every indigenous vascular plant species. Detailed information was sought about each species' distribution, subpopulation sizes, known trends, longevity and other relevant information. No allowance was made for possible declines associated with future climate change, due to insufficient quantitative data.

In simplified terms, any species that has at least a one-in-ten likelihood of becoming extinct from the domain of interest within one

[1] See the predictive maps at http://www.climatechangeinaustralia.gov.au/vicrain1.php.

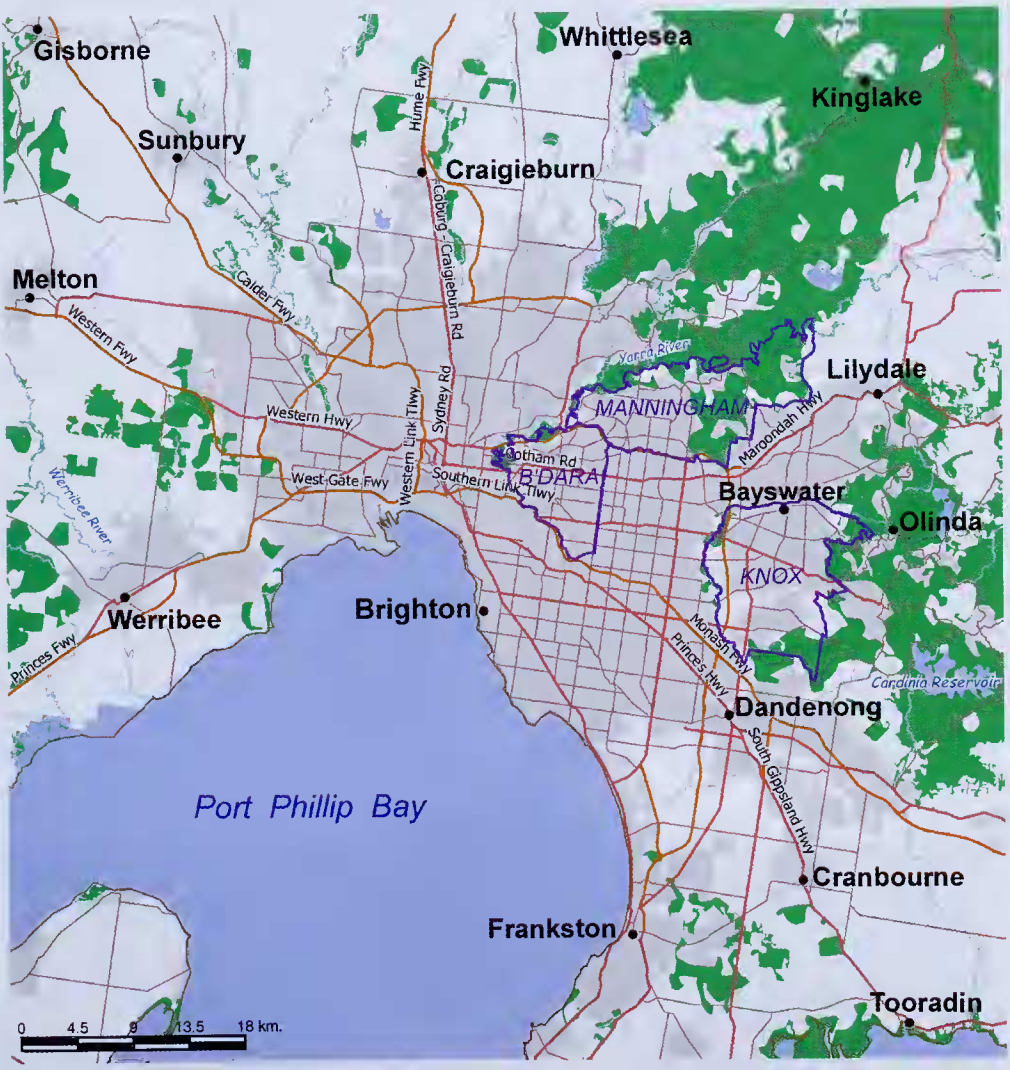

Fig. 1. Map of the Melbourne region showing the estimated extent of native vegetation in 2005 (shaded green), the three municipalities discussed in the paper (purple, with Boroondara's label shortened to 'B'dara') and some of the localities mentioned in the text. Based on a map sourced from the Biodiversity Interactive Map © The State of Victoria, Department of Sustainability and Environment, downloaded on 6th October 2011. Patches of vegetation less than a few hectares are not picked up in the mapping.

hundred years qualifies as Vulnerable under the Red List criteria. The category rises to Endangered if there is at least a one-in-five likelihood of extinction within a period of 20 years or five generations of the species (up to a maximum of 100 years). The category rises to Critically Endangered if the likelihood of extinction is at least 50% within 10 years or three generations (up to a maximum of 100 years).

Most indigenous plant species in each municipality studied were found to exceed the threshold for the Vulnerable category, and approximately 40% even exceeded the threshold for Critically Endangered (Fig. 2). The implication is that if corrective action is not taken, many indigenous plant species could disappear from the studied municipalities within a decade or so.

As species die out, their former habitats (if not destroyed) become progressively less diverse and the ecological complexity and robustness are likely to become progressively weaker, as in Ehrlich and Ehrlich's (1981) analogy of popping rivets from an aeroplane wing.

The rate at which this process continues will depend on steps that are taken to intervene, such as restoring natural hydrology to drying habitats and boosting small populations through propagation and planting. Such steps are being taken at the municipal level by Knox City Council through its 'Management Plan for Locally Threatened Species' (Lorimer 2010d). The risks faced by each species become apparent during Red List threat assessments, pointing to what can be done to ameliorate the threats.

There are many examples of successful efforts to conserve indigenous vegetation and plant species in the Melbourne region. However, it seems inevitable that for the foreseeable future, native vegetation will continue to be destroyed for urban development and major roads (DSE 2009) and much of the remaining habitat will continue to deteriorate. Proliferation of non-indigenous plants will certainly continue to be a major cause of the deterioration but climate change threatens to become the worst cause within a decade or so because it threatens even the most natural, secure and well maintained native vegetation.

The diversity of threats to Melbourne's native vegetation is matched by a diversity of possible intervention measures, such as plant breeding, land reservation and weed control. Some measures, such as alteration of the hydrology of floodplains, are innovative or experimental. Determination of how to deploy these measures most effectively requires knowledge of the magnitude of the threats at each site and how they are likely to respond to various combinations of responses.

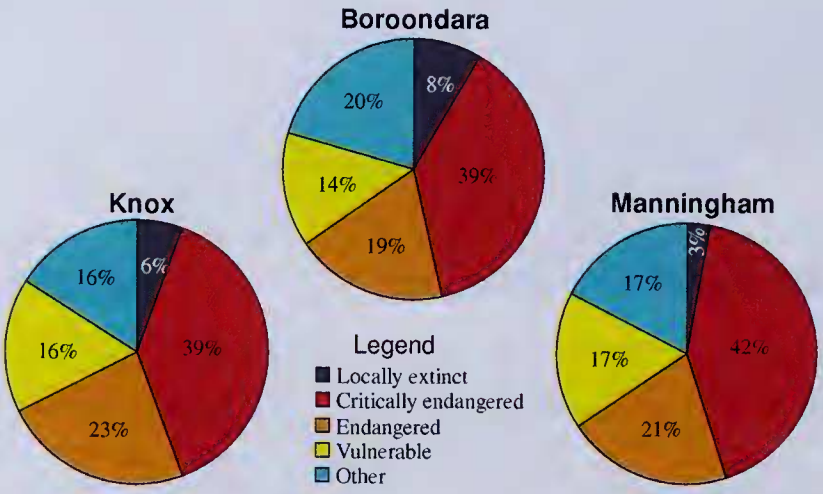

Fig. 2. Proportions of indigenous, vascular plant species at different levels of risk of local extinction in three Melbourne municipalities.

Considerable progress has been made in the three municipalities discussed above but there is plenty of scope for readers to motivate less progressive authorities or become involved in practical ways.

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Pink Heath *Epacris impressa.* Photo by Maria Gibson.

Above: (L) Silver Wattle *Acacia dealbata*; (R) *Clematis aristata*.
Below: Rough Tree Fern *Cyathea australis*.
Photos by Maria Gibson.